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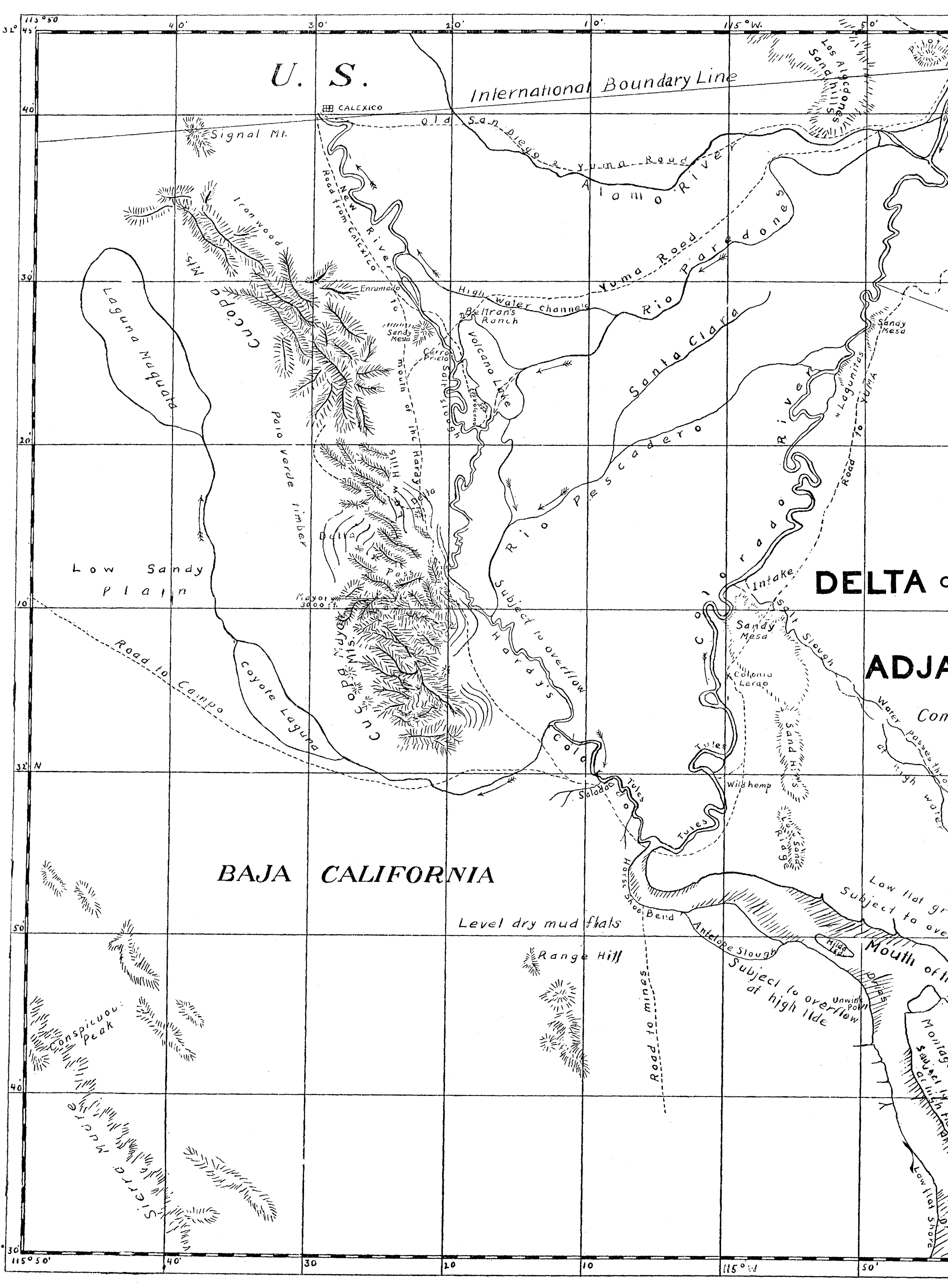
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International Boundary Line
CALEXICO
Signal Mt.
Old San Diego & Yuma Road
Alamo River
Los Algodones Sand Hills
Pilot
Ironwood
Cucopa Mts.
Laguna Maquata
New River
Road from Calexico to mouth of the Hardy
Yuma Road
Rio Paredones
Enrumado
High water channels
Beltran's Ranch
Sandy Mesa
Cerro Prieto
Salt Slough
Volcano Lake
Volcano
Santa Clara
Lagunitas
Road to Yuma
Sandy Mesa
Palo verde timber
Hills
Delta
Delta
Pass
Mayor 3000 ft.
Rio Pescadero
Colorado River
Low Sandy Plain
Road to Campo
Subject to overflow
Hardy's
Coyote Laguna
Cucopa Mts.
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Tules
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BAJA CALIFORNIA
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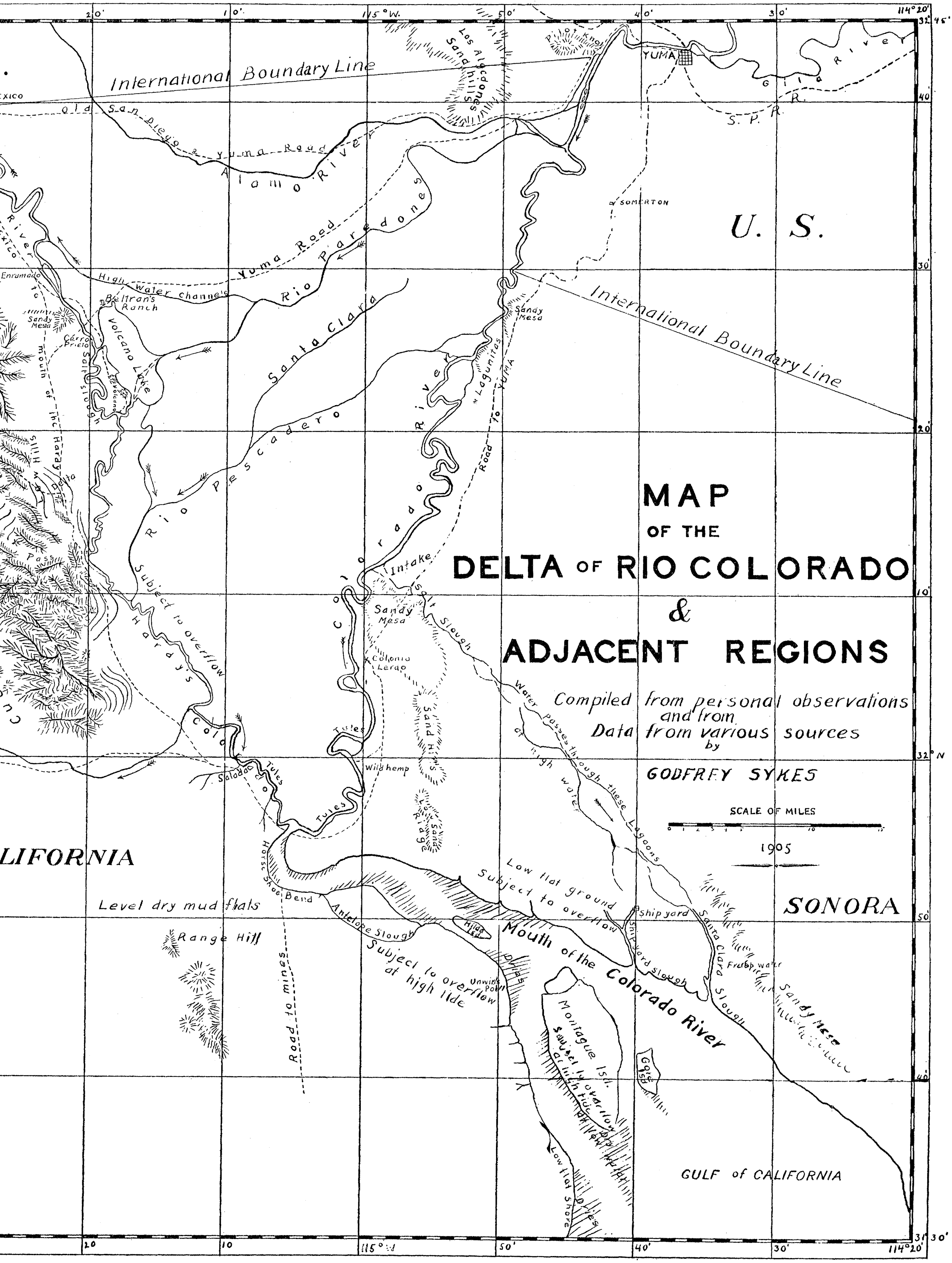


MAP OF THE DELTA OF RIO COLORADO & ADJACENT REGIONS

Compiled from personal observations and from Data from various sources by

GODFREY SYKES

1905

BULLETIN

OF THE

AMERICAN GEOGRAPHICAL SOCIETY.

Vol. XXXVIII **1906.** **No. 1**

THE DELTA OF THE RIO COLORADO.

BY

DANIEL TREMBLY MACDOUGAL.

WITH MAP BY GODFREY SYKES.

The Rio Colorado, the Nile of America, rises in the higher mountains of Wyoming and Colorado, cuts its way through cañons, mile deep for hundreds of miles, to the western edge of the great plateau, where it emerges to flow through the most arid desert in North America, finding its way into the head of the Gulf of California in a sub-tropical climate two thousand miles from its source. Here it spreads its delta with one edge to the westward against the huge sand-dunes or " algodones " of southern California, while the other stick of the fan lies far to the eastward along the margin of the Sonora mesa, where the jungle of the swamp meets the sparse vegetation of the arid gravel slopes and bluffs in striking contrast. Between the deserts to the west and to the east the radiating ribs of the delta fan, variously intertwined with subdivisions of the river, project against the Cucopa Mountains, which now rise clear-cut and cameo-like and now loom hazily against the southern horizon. The delta and the range beyond it, like many such "unknown" regions, have been visited in desultory fashion by the prospector, the hunter and trapper, and the nearest camps teem with stories of adventures, hazards, and disasters among its sloughs, tidal bores, volcanoes, sunken saline plains, and arid mountains.

The river runs at a low stage during three-fourths of the year, but in May the melting snows of the highlands swell the stream in an increasing volume until a height of a hundred feet above low-water mark is attained in the cañons during June and July, and the entire delta is practically submerged, or awash. This is the ordinary behaviour of the "great river," the only name by which it is known at present to the near-by Indian, and in accordance with immemorial custom he sows his crops in the mud of the receding waters in August and September. Once or twice in the lifetime of a man, or at intervals of fifteen to twenty years, a similar rise is caused by rains on the lower slopes in February and March resulting in serious disturbances to all life in the delta. The expedition of which the author was a member made its way through the delta on the crest of such a flood during the present year (1905). Previous visits to various portions of this interesting region had been made in company with Mr. Godfrey Sykes, who has also made several independent voyages through the estuary to the gulf. For two centuries occasional parties, attracted by the call of the "red gods" or by the lure of profit, have gone down the river to the sea, and perhaps not more than one in three of such adventurers have escaped hardship or disaster in some form.

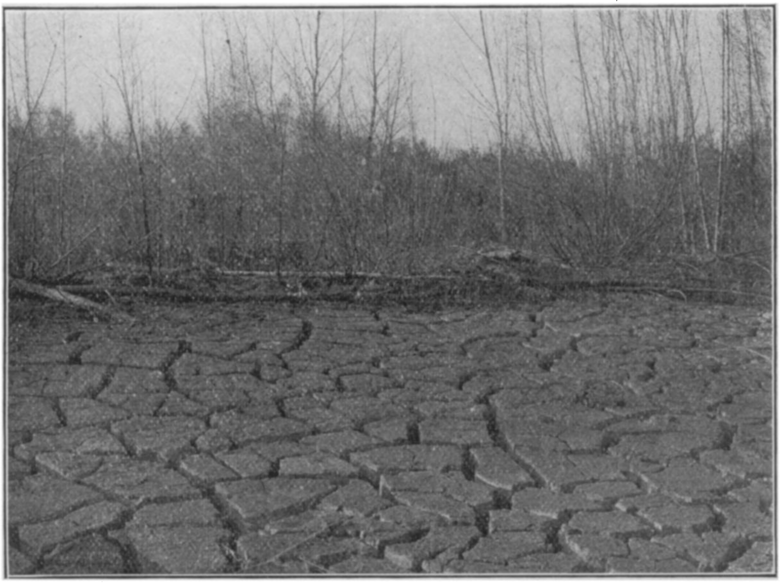


FIG. 1.— MUD FLATS SHOWING CONCHOIDAL FRACTURE WHEN DRY. MELONS AND CORN ARE PLANTED IN LARGE BOWL-SHAPED DEPRESSIONS DUG DOWN BELOW THE FRACTURES.

One of the most notable experiences of this character was that of Messrs. Skyes and MacLean in 1890, who, having started around the world in a small sloop from the head of the delta, had their boat and supplies burned on the eastern shore of Baja California, three hundred miles from civilization and a hundred miles from the nearest fresh water. Then followed a march across a veritable "Jornada del Muerto" not attempted successfully before or since by white or Indian, which was won out by an intimate knowledge of the ways of the desert and by sheer capacity for endurance. Half of the distance was made by reliance upon oysters gathered from the desolate shore, and the water from hot salty springs searched out by following the converging trails of coyotes, the same animal figuring on a bill of fare not too ornate; days of cruel plodding in the fierce heat of a tropical sun across a plain of yielding flaky saline deposit, then through all but impassable mud flats, and tule swamps of the delta to a hunter's camp found with a nicety that showed a marvellous blend of instinct with cool calculation.

The only parallel to this desert journey is to be found in the record of the Pattie party in 1828. Having been despoiled at the mouth of the Gila River by the Yuma Indians, they descended the river in dugout canoes rigged in pairs as catamarans, in search of settlements of whites. Encountering the tides and bores in the estuary, the return upstream was attempted only to be checked by a February flood, and the boats were abandoned. Under guidance of the Indians, a march was made across the desert to the snow-covered mountains to the southwestward, during two days of which the party was entirely without water. Crossing a plain ankle deep in sand, the exhausted travellers with difficulty threaded their way through the thickets of cacti to a small stream issuing from a cañon at the base of the mountains, and from here made their way to the now extinct mission of Santa Catalina and to other adventures. Neither has this journey yet been duplicated by white men.

The main channel of the river was mapped by Derby and Heintzelman in 1852, and by Ives in 1857, but its course as traced by these earlier voyagers coincides as little with the stream of the present day as with the tracings made three centuries ago by Spanish priests and soldiers. During all this period, however, the river has been cutting away at the edge of the Sonora desert at two or three points. It makes a long reach to the westward directly away from the mesa at Yuma, then a slight curve to the northward, after which it leads away to the south, passing into many involved convolutions, one of which strikes the mesa at a point marked " Sandy Bluff " but a few miles below the international boundary. A short distance down stream (eight or ten miles) the current swings back against the gravel bluffs, and then leaves the mesa to touch it again only at the gravel or sand bluffs near the head of tidal action usually known as the "Colony Mesa." The cutting action of the current is rapid and continuous at these exposures. Small rivulets of sand and gravel trickle continuously down the steep slopes of the cliffs, and occasionally large masses are detached and fall into the water with no little commotion.

At these places may be found within a compass of a hundred feet the most vivid contrasts of rank swamp vegetation and water-loving plants having broad leaves and delicate tissues with the toughened, spinose, and hairy, xerophytic forms of the desert. The presence of the moist area of the delta has but little effect upon the climate of contiguous arid regions, although a popular supposition to the contrary promises fairly to be immortal. The relative humidity here is often as low as seventeen per cent. within fifty feet of the margin of the water. During the recent visit to this region however, clouds of mosquitoes from the delta had been blown for many miles across the sandy plains, and these pestiferous swarms among the creosote and sage bushes gave a deceptive but unalluring appearance of alteration of climatic factors.

The above conditions are well illustrated by the following data, obtained in 1904. For purposes of comparison, observations were made on the alluvial plain among the leafless willows and poplars during the dry season, and the results were:—

January 28.	4:30 P.M.	60° F.	17% rel. hum.
January 28.	6:30 P.M.	55° F.	15% rel. hum.
January 28.	8:00 P.M.	51° F.	18% rel. hum.
January 29.	12:45 A.M.	32° F.	41% rel. hum.
January 29.	1:20 A.M.	30° F.	50% rel. hum.
January 29.	6:00 A.M.	29° F.	66% rel. hum.
January 29.	6:25 A.M.	27° F.	70% rel. hum.
January 29.	7:00 A.M.	38° F.	60% rel. hum.
January 29.	7:40 (Sun on instrument)		36% rel. hum.

Observations were also made on the "Upper Mesa" or "Line Mesa" at a distance of less than a hundred and fifty feet from the margin of the bank, among typical desert shrubs which were scattered over the gravel plain in characteristic fashion. The following data were obtained:—

January 30.	4:40 P.M.	70° F.	19% rel. hum.
January 30.	4:50 P.M.	68° F.	16% rel. hum.
January 30.	7:00 P.M.	54° F.	15% rel. hum.
January 30.	8:30 P.M.	48° F.	27% rel. hum.
January 31.	7:30 A.M.	45° F.	29% rel. hum.
January 31.	6:30 A.M.	44° F.	30% rel. hum.

The high level of the March flood, being fairly uniform, is very useful in determining certain topographical features of the delta and its relation to the adjacent territory. Thus an old trapper who had frequented the river twenty-five years ago had left behind him the tradition that a channel left the main river above tidewater, and seventy-five miles from the mouth, and flowed southeasterly into the head of the Gulf of California—an assertion which had never been confirmed. The only known depression suitable for such a flood-waterway would be offered by the Santa Clara River, a shallow stream which heads back from the Gulf into the Sonora desert some distance from the river and sends a feeble current of salty water through its shallow reaches to the sea. An investigation of this feature from a camp near the head of the Santa Clara showed that the reddish waters of the Colorado left the main channel just above the "Colony Mesa" and flowed in great volume through a depression into the Santa Clara, forming a navigable stream which might easily, with a shift of the cutting action of the current, become the main way of the Colorado.

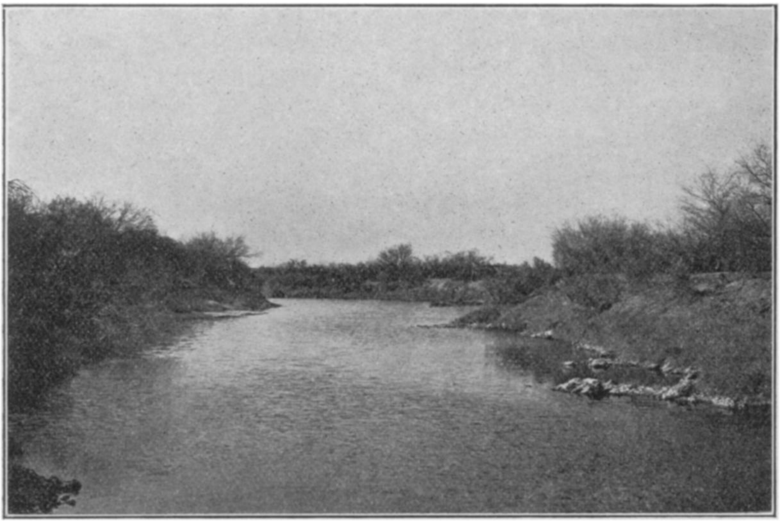


FIG. 2.—THE SANTA CLARA RIVER, ONE OF THE HIGH-WATER OUTLETS OF THE COLORADO RIVER, NEAR COLONIA LERDO.

An immense amount of sediment, which has been estimated at sixty million tons yearly, is carried down into the delta and deposited on the bars and banks of the various channels, giving rise to the assertion that appreciable construction of solid land has occurred within the observation of persons now living. This view is supported by the fact that the willows and poplars, which do not inhabit the lowest land moistened with brackish water, have advanced about ten miles farther south within the memory of certain Indians, and also by the formation of Hilda Island in the lower reach of the river, which is recorded on the accompanying map for the first time, and which was first noted by Mr. Godfrey Sykes while descending the river in the sloop Hilda in 1890.

The sparse records of the last century show that islands have appeared and disappeared in the lower reaches of the river in a very capricious fashion. The funnel-shaped head of the Gulf of California shoals abruptly in the mouth of the river, and flood-tides reach a height of forty-one feet above low water. These conditions lead to the formation of a bore which sweeps upstream at the close of the ebb in a comber four to six feet in height, striking the exposed shores with great violence and starting new points of erosion and shoal deposit. Within the region affected by the tides, the tules and tall

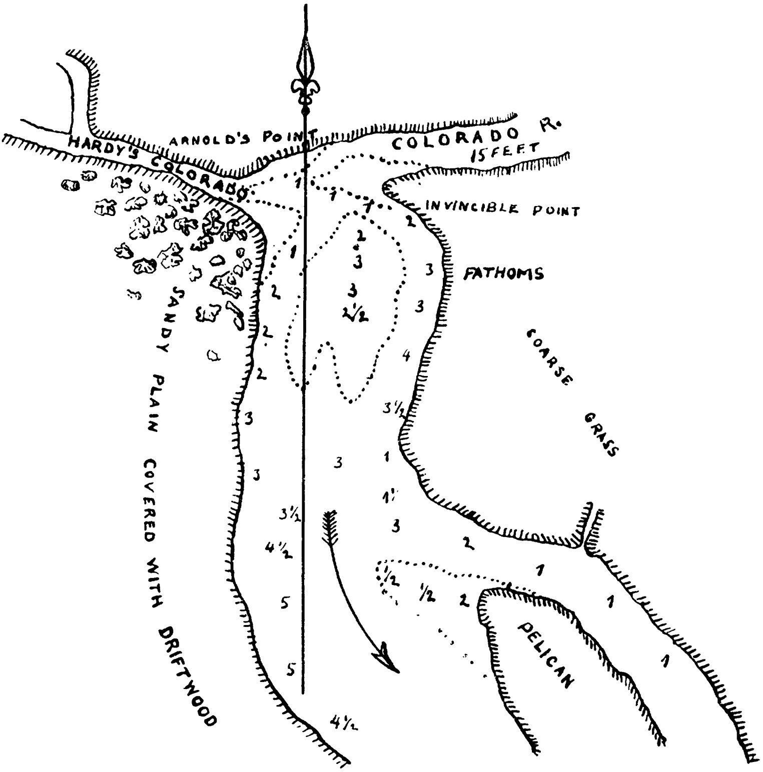
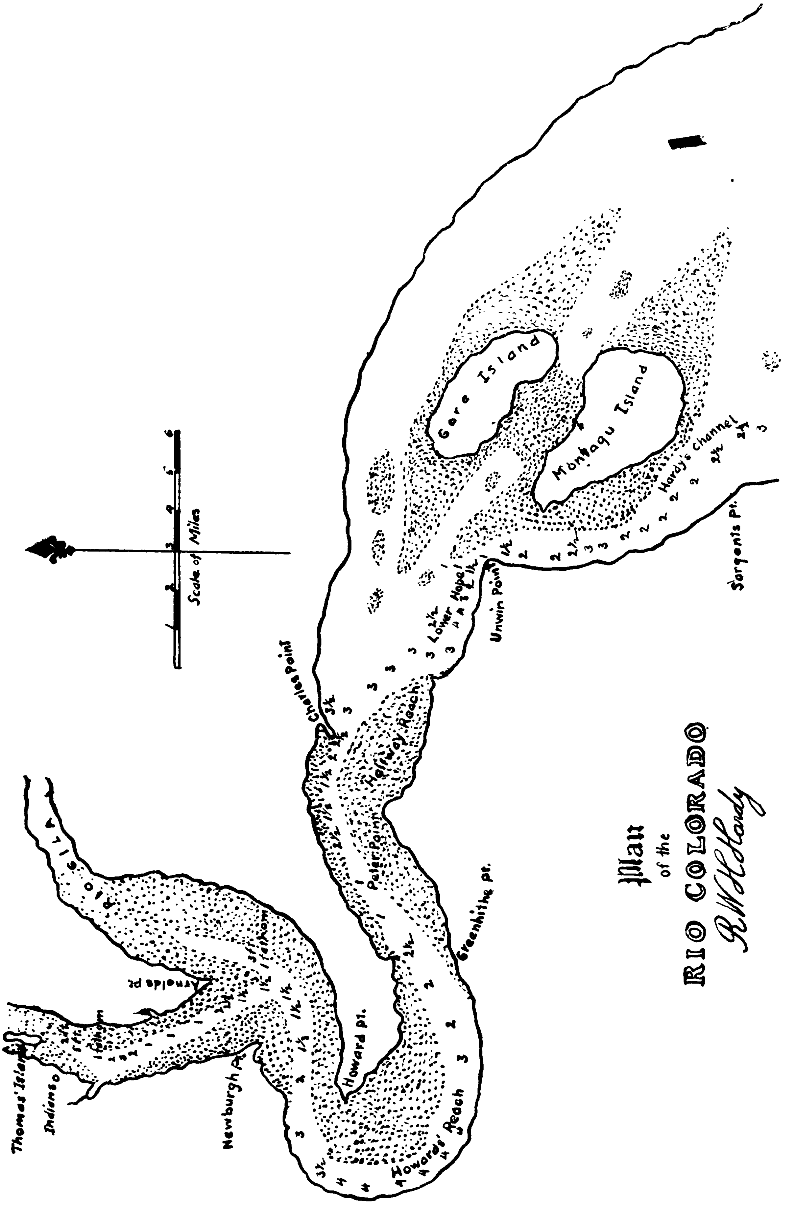


FIG. 3.—SKETCH OF THE MOUTH OF THE COLORADO RIVER MADE BY LIEUTENANT DERBY IN 1850, DIFFERING SLIGHTLY FROM THE GENERAL MAP OF THE WHOLE RIVER MADE BY HIM AND MAJOR HEINTZELMAN.


Map of the RIO COLORADO
R W H Hardy
Scale of Miles
1
2
3
4
5
6
Gore Island
Montagu Island
Hardy's Channel
Sargents Pt.
Unwin Point
Lower Hope
Charles Point
Halfway Reach
Peter Point
Greenhithe pt.
Howard pt.
Howards' Reach
Newburgh Pt.
Arnolds Pt.
Rio Gila
Indians
Thomas' Island
1 fathom

vegetation along the shores may be seen to be leaning upstream as a result of the smashing effect of the uprushing bore, which is a serious menace to all but the largest craft which seek to navigate the river.

In 1826 Lieut. R. W. H. Hardy, "Commissioner of the General Pearl and Coral Fisheries of London," made up the lower reaches of the river in a small vessel to a point where a wide stream was seen coming in from the northwestward, which he mistook for the Colorado. This stream is now known as Hardy's Colorado, and is the channel which binds together the ribs of the delta fan, gathering the water which leaves the Colorado in the Pescadero, Paredones, and other unnamed channels, and emptying it back into the main river before it reaches the Gulf. Not all of the water, however, which leaves the main river returns to it, or finds a way to the sea.

The Hardy has its origin in a shallow body of water known as Volcano Lake, which lies in the western part of the delta on the crest of a gentle swell, and which receives the water of the Paredones running out of the Colorado. To the northwestward the drainage from this lake is toward the Salton basin, which is from fifty to a hundred and twenty-five miles in diameter, and which has its salt-covered floor more than three hundred feet below sea-level. Water which flows out of Volcano Lake through New River to the westward, as well as other channels coming directly or indirectly from the Colorado, trickles over the edge of the giant bowl and rushes down its steep slopes, forming a lake in the bottom of the basin. Such floods, re-forming Salton Lake, occurred in 1828, 1849, 1861-2, 1891, 1905, and perhaps in other years in which records are not available. This last flood poured enough water into the basin to form a lake with an area of about six hundred square miles, which in November, 1905, was reported to be increasing in depth and extent.

According to Indian traditions, this great basin has been filled to the brim in times past, abounded in fish, and people lived along its margin in many villages. "Poco a Poco" the floods receded, however, until a desert remained. The floods within historic times have in some instances poured vast quantities of water into the basin; but this generally evaporates in a few months in the blazing heat of the sun, which gives temperatures of about one hundred and twenty degrees Fahrenheit in the shade, and which has an evaporating capacity of twelve to twenty feet of water yearly.

The intake of additional quantities of water into the sunken basin is now facilitated by a huge canal led off from the Alamo Slough and the Colorado River for the purpose of irrigating lands lying around the upper rim of the bowl, and the reappearance of the ancient sea as a permanent feature is by no means among the impossibilities.

Another basin below the sea-level connected with the delta is to be found on the farther side of the Cucopa Mountains, which bound the delta on the southwest. During floods the waters bathe the entire eastern foot of the mountains, and great volumes find a way around the southern end of the range to this basin, filling the depression in two places known as the Laguna Maquata and Coyote Laguna. These are also soon dried up after the supply of water ceases.

The topographical features described above combine to make the Cucopa Mountains, which are to be reckoned as among the most arid on the continent, a peninsular ridge at high water connected with dry land by a narrow strip a few feet only above sea-level, and extending northwestward across the international boundary.

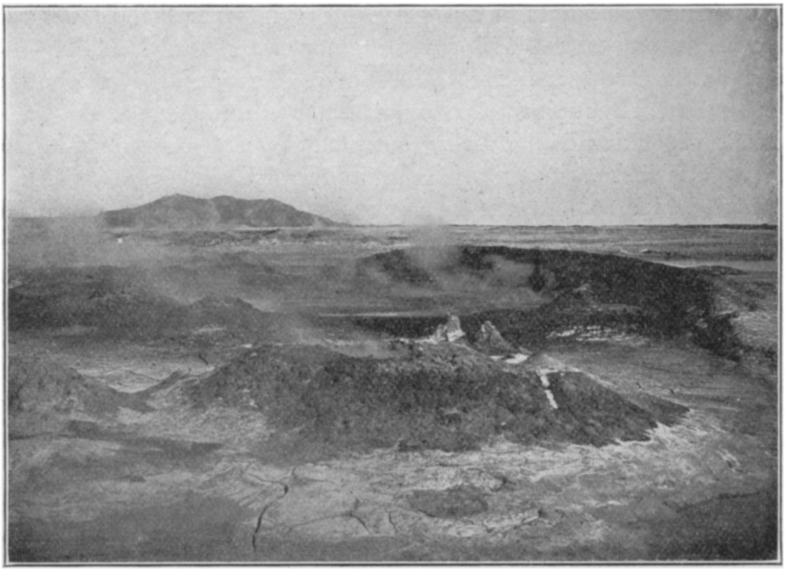


FIG. 5.—ACTIVE MUD-VOLCANOES NEAR VOLCANO LAKE. CERRO PRIETO, THE LARGEST OF THE GROUP SEEN IN THE DISTANCE, IS NOW QUIESCENT.

Not unexpectedly to the naturalist, this range affords many endemic species of plants and animals, and those which range beyond its confines bear a more intimate relation with the forms inhabiting the mainland of Mexico and Arizona than to the remainder of peninsular California.

Hot springs and other manifestations of volcanic energy are to be found all along the geological vault on the eastern side of the peninsula of Baja California, but the most pronouncd feature of this character is to be found well out in the delta near Volcano Lake. Here on a saline plain a few miles in extent innumerable small mud cones, solfataras, and boiling pools of mud and water emit steam, smoke, and sulphurous gases, accompanied by a dull rumbling sound. According to the traditions of the Cucopa Indians, formerly a member of the tribe accused of sorcery or other serious crime was sent back to his evil master by the simple process of dropping him into a pool of boiling mud—an obvious entrance to his abode below. Flood-water covers a number of the small volcanoes, and then quite an extended area of the lake is agitated by the eruptions from below.

The largest of the volcanoes, known as the "Cerro Prieto," stands on the margin of the gravel slopes leading down from the main range of the Cucopa Mountains and rises as an irregular black mountain to a height of 750 feet, with several minor craters on its sides. The main crater is regular in form, and shows indications of activity at no remote time, although the bottom of the bowl now bears the characteristic vegetation of the desert, but including some species not now known elsewhere. In connection with the volcanoes are some boiling springs, which come to the surface a few feet above the level of the flood-water which flows from Volcano Lake into the Hardy. Immersed in the steaming water is a blue-green alga, which has been hitherto reported only from similar hot springs in Algeria, offering a problem in distribution the solution of which cannot even be conjectured.

The portion of the delta included in the Salton basin, which lies below sea level, and which is mostly within the State of California, is a true desert by means of its aridity and the saline character of the soil; consequently the plants and animals are referable to the Colorado desert, of which it in reality forms a part. The area actually irrigated by the river in normal low water and flood, however, is surrounded on all sides by desert and salt water, and is in reality a biological island. As such it offers an interesting comparison with the Cucopa Mountains, which limit it on the southwest, and which also constitute a sharply-defined life-area.

The quantity of food furnished by the swampy jungles is sufficient to support a vast amount of native animal life, and furnishes inviting feeding grounds for migrating birds. The countless millions of young willow and poplar shoots supply food for the beaver, which bids well to hold out long in the impassable bayous and swamps against its trapper foe.

The soil, climate, moisture, and temperature of the entire delta are fairly uniform, and also differ but little in elevation and exposure—a condition which tends to promote the multiplication of the number of individuals of a few species of plants, and these species are also able to maintain themselves in pure culture of some extent. An analysis of the vegetation of the delta confirms this view. Canes (*Phragmites*), cattails (*Typha*), willows (*Salix*), poplars (*Populus*) arrow-weed (*Pluchea sericea*), quelite (*Amaranthus Palmeri*), wild hemp (*Sesbania*), each occupy extensive areas, to the almost total exclusion of other seed-plants, although there are many places in which several of these will be found contending for the mastery. In all such areas of unstable equilibrium some change of the drainage, or of the action of the river, will be found as a disturbing cause.

Nearer the Gulf are found great sloughs, in which are extensive fields of the "wild rice" (*Uniola Palmeri*), while the land subject to the action of the overflow of the tides supports a carpet of salt-grass (*Distichlis*) and *Cressa.* Throughout the entire delta the mesquite (*Prosopis velutinea*) and the screwbean (*Prosopis pubescens*) dot the landscape, and furnish examples of one of the few components of the vegetation, the individuals of which grow singly and apart. The salt bush (*Atriplex*) also grows singly in great globular bunches overtopping the head of a man, on the lower stretches of saline soil.

In the enumeration of the following plants which have been found in various parts of the delta occasion is also taken to add notes as to known uses made of them by the Cucopa Indians:

Achronychia Cooperi A. Gray.
Saline soil near Volcano Lake.

Amaranthus Palmeri. Quelite.
Growing in open ground flooded at highest water. The young plants furnish forage for grazing animals, and are also eaten by the Indians. The mature plant reaches a height of 10 ft., and develops a crop of small shiny seeds, which are collected and stored for use as food.

Ammania latifolia L.
Along the Colorado on exposed banks.

Atriplex fasciculata S. Wats.
In saline soil near Volcano Lake.

Cressa Truxillensis H.B. K.
Mud-flats, forming extensive carpets with salt-grass in the southern part of the delta, in which the soil is slightly saline.

Cucurbita palmata.
Low ground throughout the delta.

Diplachne imbricata (Thurb).

Along the banks of the river and streamways.

Distichlis spicata (L.) Greene. Salt grass.

Forming carpet with Cressa in southern part of the delta, in which the soil is saline.

Echinochloa Crus-galli (L.).

Low ground near bayous and wet places. The seeds of this grass are probably to be included among those used for food.

Eclipta alba (L.). Hook.

Along the banks of the Rio Colorado near the margin of the stream.

Lippia cuneifolia (Torr.). Skud.

Exposed banks and bare places near the river.

Phragmites Phragmites. Cane, Carrizo, Tule.

Along the margins of streams, forming dense brakes. Used for making huts, flutes, and also in the construction of various articles.

Pluchea sericea (Nutt.). Coville. Arrow-weed.

In dense copses, forming pure cultures on banks above ordinary flood-level. Used by Cucopa Indians to form the shafts of arrows, to make the wattling and roofing of huts, for weaving coarse baskets, and granaries, etc.

Populus.

The young shoots are used, with willows, for wattling and portions of trunks for construction of huts.

Prosopis pubescens. Tornillo. Screw-bean.

Wood used in the same manner as the mesquite.

Prosopis velutinea. Mesquite.

The wood of the trunks is used for construction of all kinds, for making fires, and for tipping the points of arrows. The beans are collected and used for food.

Rumex sp. Dock.

Moist soil in open spaces.

Salix. Willow.

Two species are abundant throughout the delta, and these furnish material for use in huts, for the making of small hunting bows, and for miscellaneous purposes.

Scirpus fluviatilis A. Gray.

Mud flats throughout the delta.

Scirpus Californicus (C. A. Meyer). Britton.

Margins of streams.

Sesbania macrocarpa. Wild hemp. Wild flax.

Grows in open portions of the delta below flood-level, and sometimes reaches a height of 15 ft. The stems furnish a fibre which is used by the Indians for bow-strings and for other purposes as cords. Some attempts have been made to introduce this fibre into commerce.

Sesuvium sessile.

Along the shores of streams in the lower portion of the delta, in which the soil is moistened by water slightly saline or brackish.

Allenrolfia occidentalis.

Along the Santa Clara slough and other areas, in which the soil is saline.

Typha latifolia. Cat-tail tule.

Growing in level areas below flood-level and multiplying rapidly by means of offsets and forming pure cultures of great area. The underground stems, which are tender and succulent, are eaten by the wild hogs, while the sword-shaped leaves are used to pack the interstices of huts, and especially the small sweat-houses which are erected at the margins of lagoons. The great smokes which are seen almost constantly in the delta are mainly made by burning brakes of cat-tails for hunting purposes.

Uniola Palmeri. Wild rice.

Grows in the sloughs and wet places in the southern part of the delta, and the seeds are used as food by the Cucopa Indians.

At one time a herd of domestic hogs were turned loose in the tule swamps of the delta, and their progeny have reverted in so many features as to be as savage and untamable as their ancestors of a thousand years ago. Here, preying upon the hog and deer, is also to be found a "mountain lion," of a variety not found elsewhere, and even the widely-ranging coyote constitutes a species peculiar to the region, and quite at home in the mud of the swamps and bayous.

Surpassing in interest all other features of the delta is the Cucopa Indian, who inhabits it, and who is the heir and successor of many vanished tribes. First mentioned in the records of the expedition of Coronado in 1540 as seen to habitually carry fire-brands, which these old explorers naïvely thought was done for the purpose of keeping the hands warm, they were designated as the Tizon (firebrand) Indians, and the river received the same name. As a matter of fact, smouldering fagots were carried for the simple purpose of preserving fire and for its convenient use in burning the tules and canes to drive out animals hunted for food. At the beginning of the seventeenth century, Oñate descended the river to the mouth, and estimated that twenty thousand Indians were living in the eastern part of the delta alone, including various tribes, such as the Hatchedumas and Tlalliguamayas; but these, as well as the Quiquimas and Cutganes of the western part of the delta, have long since vanished from the region. Even as late as 1826 Hardy saw many thousands of Cucopas around the mouth of the Hardy; yet to-day the total population of the delta and the adjacent habitable part of the desert does not exceed three hundred. The only relics of the vanished hordes consist in hundreds of square miles of sandy plains strewn with fragments of coarse red pottery, and a prehistoric trail along the eastern foot of the Cucopa Mounains at the southwestern edge of the delta. For many miles the waters of the Hardy actually bathe the base of the rocky declivities, and along here the highway, as old as the race itself perhaps, is crowded into a narrow path. For untold cycles, until within a century, this trail must have been one of the most travelled of the southwest, since it led from the interior deserts and mountains to the wild rice fields and fishing grounds at the head of the Gulf, and was doubtless an inter-tribal highway of scarcely less importance than that along the Gila.

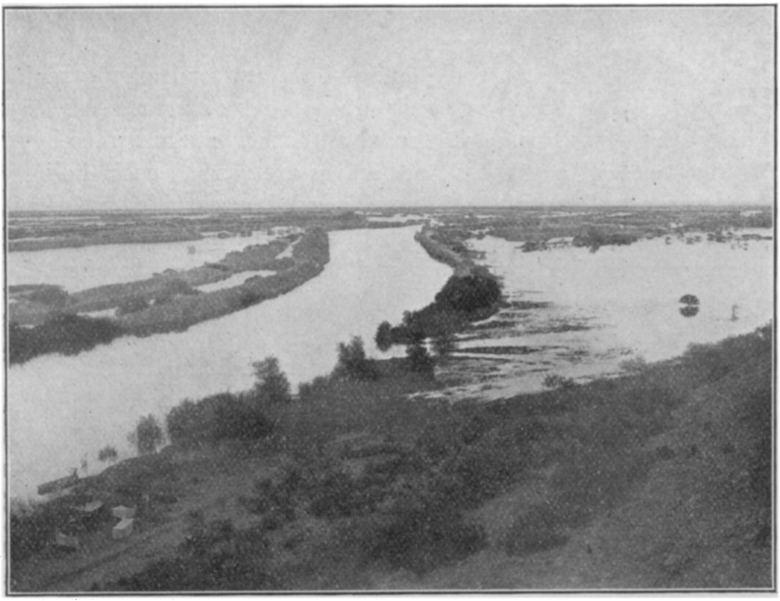


FIG. 6.—HARDY RIVER AT BASE OF CUCOPA MOUNTAINS. THE CHANNEL IS LINED WITH WILLOWS, CATTAILS, MESQUITE AND TULES. BETWEEN THE CAMP AND THE BASE OF THE SLOPE IS THE ANCIENT INDIAN TRAIL.

Within recent times the Cucopa Indians have been bested in a war with the Yumas at the head of the delta, but neither the losses suffered in this defeat nor traditions of other wars may account for this diminishing population. In the losing struggle carried on by this dwindling remnant, the deleterious effects of civilization have played but small part. Similar decreases of population in fertile river deltas are not unknown in other parts of the world. The native of the Colorado delta is a sturdy, well-built, peace-loving farmer of industrious habits by the standards prevailing in the land of the mañana, but he is notably lacking in handicraft or manual expertness of any kind. Living in a land cut and intersected in all directions by streams, he is neither a skilful boat-builder nor an expert canoeist, while the unaccountable tides and bores of the Gulf fill him with dread. The river teems with fish easily caught at times, and he lacks this food entirely when fishing becomes difficult. The tules swarm with game of many kinds, but the Cucopa is not a shrewd hunter. By the custom of his tribe all of his most necessary articles of personal use are burned or destroyed upon the death of a near relative, in consequence of which he does not weave textiles, make pottery, or build houses with enthusiasm or enduring effect, and is almost devoid of means of artistic expression of the symbols of his history or beliefs, and his diminishing numbers seem but an obvious illustration of the non-survival of the unfit.

The struggle for existence in the jungles of the warmer portions of the earth is one in which the human animal is often unsuccessful. The chief force against which he must contend is the rampant growth of vegetation, which impedes his agricultural efforts, and which makes all but impossible the breeding and preservation of domestic animals. Then in the protection of the jungle, wild animal life, from the most minute to the largest, multiplies with such rapidity as to constitute a hindrance to profitable effort, if not a formidable menace to health and bodily safety. Add to these the yearly summer inundation of the lands of the delta and the occasional flood of the winter, and conditions are created which may be met successfully only by the highly-organized methods of civilized society, and not by the intermittent, badly-directed individual effort of the aboriginal, who at best but holds his own in such a contest. With every pulsation of the summer heat the jungle closes a hardly measurable but positive accretion about his fields; with the loss of a working member of the family circle he handicaps himself to the limit of all he has previously gained, and when the creeping flood silently covers the land and drives him unprovided to the desert he must repeat the history of his race to regain his previous advantages.

With the initiation of the Yuma project for irrigation of the areas contiguous to the river in and around the head of the delta, a movement has begun which will make the alluvial lands a home of many thousands. The work of converting the delta to the uses of civilization will be hindered by the fact that some of the main drainage channels cross and then recross an international boundary; but doubtless in a comparatively brief period the agricultural aspect of the entire area will approach that of the Nile, which has supported a teeming population for centuries.

TOPOGRAPHIC SURVEYS OF THE UNITED STATES IN 1905.

During the season of 1905 topographic mapping was continued with vigour in the eastern portion of the United States. In Maine the U. S. Geological Survey, in co-operation with the State Survey, completed the mapping of an area of about 220 square miles on the upper Kennebec River, in Somerset County. The scale of this work was one mile to one inch, and the relief is shown in contours of twenty-foot interval. This region is just below Moosehead Lake, and has been lumbered over extensively in past years. It has been overgrown in recent years with second growth, is practically impenetrable by roads or paths, and abounds in game, including large numbers of grouse and deer and some moose. The map of this region will be of great value to lumbermen and to engineers, some of whom are now engaged in extending the Somerset County Railroad north from Bingham. Incidentally, the Hydrographic Branch of the Geological Survey made detailed surveys of Moosehead Lake and of the Moose River and the lakes along it, including Brasson and Long Pond. These latter investigations are made to determine the storage capacity of this region for supplementing the flow of the river for the production of water-power.

Very little progress was made in the topographic mapping of New York as compared with previous years, because of the failure of the Governor to approve the bill which had passed the State Legislature for continuing the topographic survey of the State in co-operation with the United States Geological Survey. Accordingly, after plans had been perfected for pushing the survey of the State to completion, the parties had to be withdrawn, and only a little work was done to close up some partially-mapped areas. This included about 900 square miles mapped near Loon